

Date: April 27, 2001

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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 USC 371

International Application No.: PCT/RU99/00053
International Filing Date: March 1, 1999
Priority Date Claimed: December 8, 1998
Title of Invention: MULTILAYERED CONNECTION PLATE
Applicant(s) for DO/EO/US: Aleksander Ivanovich Taran

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. (X) This is a **FIRST** submission of items concerning a filing under 35 USC 371.
2. () This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.
3. (X) This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).
4. () A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. (X) A copy of the International Application as filed (35 USC 371(c)(2))
 - a) (X) is transmitted herewith (required only if not transmitted by the International Bureau).
 - b) () has been transmitted by the International Bureau.
 - c) () is not required, as the application was filed in the United States Receiving Office (RO/US).
6. (X) A translation of the International Application into English (35 USC 371(c)(2)).
7. (X) Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))
 - a) () are transmitted herewith (required only if not transmitted by the International Bureau).
 - b) () have been transmitted by the International Bureau.
 - c) () have not been made; however, the time limit for making such amendments has NOT expired.
 - d) (X) have not been made and will not be made.
8. () A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).
9. (X) An oath or declaration of the inventor(s) (35 USC 371(c)(4)).
10. () A copy of the International Preliminary Examination Report with any annexes thereto, such as any amendments made under PCT Article 34.
11. () A translation of the annexes, such as any amendments made under PCT Article 34, to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

U.S. Application No.
Unknown

International Application No.
PCT/RU99/00053

U97830654
JC18 Rec'd PCT/PTO 27 APR 2001
Attorney Docket No.
VALER12.001APC

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Items 11. to 16. below concern other document(s) or information included:

12. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14. ☒ A FIRST preliminary amendment.
☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or address letter.
17. ☒ International Application as published.
18. ☒ Small Entity Statement.
19. ☐ PCT Form PCT/IPEA/402.
20. ☐ PCT Form PCT/IB/308.
21. ☐ PCT request form.
22. ☒ Other Items or information:
International Search Report
23. ☒ A return prepaid postcard.
24. ☒ The following fees are submitted:

097830654

Megumi Tanaka
Patent Engineer

Assistant Commissioner for Patents
Washington, D.C. 20231

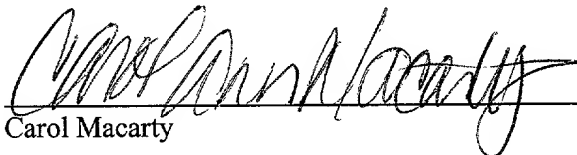
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Attorney Docket No. : VALER12.001APC
Applicant(s) : Aleksander Ivanovich Taran
For : MULTILAYERED CONNECTION PLATE
Attorney : John M. Carson
"Express Mail"
Mailing Label No. : EL717639746US
Date of Deposit : April 27, 2001

I hereby certify that the accompanying

Transmittal; International Application as published; English Translation of the Application; Preliminary Amendment in 5 pages; **SIGNED** Declaration and Power of Attorney in 1 pages; International Search Report; Small Entity Statement(s); Check(s) for Filing Fee(s); Return Prepaid Postcard

are being deposited with the United States Postal Service "Express Mail Post Office To Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.


Carol Macarty

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U.S. Application No.
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				FEES
BASIC FEE				\$1,000
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total Claims	11 - 20 =	0 ×	\$18	\$0
Independent Claims	4 - 3 =	1 ×	\$80	\$80
Multiple dependent claims(s) (if applicable)			\$270	\$0
TOTAL OF ABOVE CALCULATIONS				\$1080
Reduction by 1/2 for filing by small entity (if applicable). Verified Small Entity \$ statement must also be filed. (NOTE 37 CFR 1.9, 1.27, 1.28)				
TOTAL NATIONAL FEE				\$1080
TOTAL FEES ENCLOSED				\$1080
amount to be refunded:				\$
amount to be charged:				\$

25. (X) A check in the amount of \$1080 to cover the above fees is enclosed.
26. () Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40 per property.
27. (X) The Commissioner is hereby authorized to charge only those additional fees which may be required, now or in the future, to avoid abandonment of the application, or credit any overpayment to Deposit Account No. 11-1410. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Knobbe, Martens, Olson & Bear, LLP
620 Newport Center Drive
Sixteenth Floor
Newport Beach, CA 92660

Signature

John M. Carson
Printed Name

34,303
Registration Number

VALER12.001APC

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Taran, Aleksander Ivanovich
Appl. No.	: Unknown
Filed	: Herewith
For	: MULTILAYERED CONNECTION PLATE
Examiner	: Unknown

Group Art Unit Unknown

I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Assistant Commissioner for Parents, Washington, D C 20231, on

April 27, 2001
(Date)

John M. Carson, Reg. No. 34,303

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please enter the following amendment to the above-referenced application before examination of the application on the merits.

IN THE CLAIMS:

Please cancel Claims 1-8.

Please add the following claims:

9. (New) A multilayered connection plate, comprising:
- a plurality of layers of a dielectric material having conductive paths on their surfaces, the layers being connection layers; and
- a plurality of contact nodes in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by a conductive binding material, wherein the contact nodes are made in the form of joints between the contacts, some of which contacts are contact pads coupled with conductive paths of the underlying connection layer, and other contacts aligned with the contact pads are made in the form of

metallized holes formed as truncated cones in the upper-lying connection layer, the narrower bases of the truncated cones being faced to the contact pads of the underlying connection layer, and the wider bases of the truncated cones being coupled with the conductive paths on the upper side of the upper-lying connection layer.

10. (New) The multilayered connection plate according to Claim 9, wherein the contact pads are flat.

11. (New) The multilayered connection plate according to Claim 9, wherein the upper bases of the truncated cones coupled with the conductive paths on the surface of the connection layer are made with metallized rims around the periphery of the bases.

12. (New) The multilayered connection plate according to Claim 11, wherein the diameter D of the greater base of the truncated cone, the width h of the metallized rim, the diameter d of the lesser base of the truncated cone, the thickness t of the dielectric material of the connection layer and the minimal width L of the respective contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h.$$

13. (New) A multilayered connection plate, comprising:

a plurality of layers of a dielectric material with conductive paths on their surfaces, the layers being connection layers; and

a plurality of contact nodes in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by conductive binding material, wherein the conductive paths are placed on both sides of every connection layer and interconnected with metallized through holes within every layer, insulating layers with metallized through holes are placed between the connection layers, and the contact nodes comprise metallized holes in the form of truncated cones made in the upper-lying connection layer, metallized through holes in the insulating layer, and contact pads coupled by conductive binding material on the underlying connection layer, the lower bases of the truncated cones being joined with the upper bases of metallized through holes of the insulating layer, and the lower bases of the through holes are joined with the contact pads of the underlying connection layer, coupled with the conductive paths on the upper side of the underlying connection layer, the upper bases of the truncated cones

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being coupled with the conductive paths placed on the upper side of the upper-lying connection layer.

14. (New) The multilayered connection plate according to Claim 13, wherein the contact pads are flat.

15. (New) The multilayered connection plate according to Claim 13, wherein the upper and lower bases of the truncated cones coupled with the conductive paths on the surfaces of every connection layer are made with metallized rims around the periphery of the bases.

16. (New) The multilayered connection plate according to Claim 13, wherein the metallized through holes of the insulating layers are made in the form of cylinders with metallized rims being formed around the periphery of the upper and lower bases.

17. (New) A multilayered connection plate, comprising:

a first connection layer having a conductive path on a surface thereof;

a second connection layer deposited adjacent to the first connection layer having a conductive path on a surface thereof;

a first node provided through the first connection layer and having a metallized hole, an inner surface of which is connected to the conductive path of the first connection layer, and a contact pad connected with the conductive path of the second connection layer, wherein a conductive binding material is deposited in the metallized hole to be in contact with the inner surface of the metallized hole and the contact pad so as to form a connection between the first and second connection layers;

a third connection layer deposited adjacent to the second connection layer having a conductive path on a surface thereof; and

a second node provided through the second connection layer having a metallized hole, an inner surface of which is connected to the conductive path of the second connection layer, and a contact pad connected with the conductive path of the third connection layer, wherein a conductive binding material is deposited in the metallized hole to be in contact with the inner surface of the metallized hole and the contact pad so as to form connection between the second and third connection layers.

18. (New) A multilayered connection plate, comprising:

a first connection layer having a conductive path on a surface thereof;

an insulating layer deposited adjacent to the first connection layer

a second connection layer deposited adjacent to the insulating layer and opposite to the first connection layer and having a conductive path on a surface thereof; and

a node provided through the first connection layer and the first insulating layer and having a metallized hole provided through the first connection layer, an inner surface of which is connected to the conductive path of the first connection layer, a metallized through hole provided through the first insulating layer, and a contact pad connected with the conductive path of the second connection layer, wherein a conductive binding material is deposited in the metallized hole and the metallized through hole to be in contact with each inner surface of the metallized hole and the metallized through hole and the contact pad so as to form connection between the first and second connection layers.

19. (New) The multilayered connection plate according to Claim 18, further comprising:

a second insulating layer deposited adjacent to the second connection layer and opposite to the first insulating layer;

a third connection layer deposited adjacent to the second insulating layer and opposite to the second connection layer; and

another node provided through the second connection layer and the second insulating layer and having a metallized hole provided through the second connection layer, an inner surface of which is connected to the conductive path of the second connection layer, a metallized through hole provided through the second insulating layer, and a contact pad connected with the conductive path of the third connection layer, wherein a conductive binding material is deposited in the metallized hole and the metallized through hole to be in contact with each inner surface of the metallized hole and the metallized through hole and the contact pad so as to form connection between the second and third connection layers.

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REMARKS

The amendments to Claims 9-16 have been made to conform to United States practice.
Claims 17-19 have been added. No new matter has been introduced.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 4/27/01

By: 

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MULTILAYERED CONNECTION PLATE

Field of the invention

The invention relates to the development and production of an equipment based on microelectronics components and semiconductor devices, and may be widely used in the production of multilayered connection plates. The invention is directed on reducing the labor input and cost of producing the multilayered plates while increasing the conductor spreading density and reducing the number of connection layers. An application of the present invention in producing the connection printed circuit cards for mass electronic equipment with high specific characteristics in the form of multichip modules (MCM) is particularly promising.

Background of the invention

A multilayered plate based on alumina ceramics is known, the plate comprising alternating ceramic layers on which surfaces are formed conductors by applying and burning the conductive paste. The conductors of adjacent layers are coupled each other by means of holes in ceramic layers filled with a conductive paste which forms, after heat treating, contact nodes for connecting the conductors placed on the surfaces of adjacent layers according to a specific connection scheme (SU 1443781 A, Int. Cl. H 05 K 3/46, 1987).

Advantages of the ceramic multilayered plates are the group character and producing adaptability of processes for forming the contact nodes and assembling the layers into a single multilayered plate.

Nevertheless, the multilayered ceramic plates have great weight and substantial thickness with the contact spreading density and the number of connection layers which do not meet the requirements placed to the modern electronic equipment based on components with great number of leads spaced with a fine

pitch. Moreover, due to substantial technological differences in linear sizes of mounting elements on the plate surface, in a high-temperature treating of ceramics (ceramics caking conditions are hardly controllable) great problems occur with aligning contact pads on the plate and precision leads of housing components, which impedes an automation of component mounting on the plate surface, and finally, leads to rising a cost of the equipment based on ceramic plates. Even greater difficulties occur while performing the mounting of housing-less IC chips with great number of leading contacts. Thus, the ceramic multilayered plates are generally used in a special equipment with high requirements on a resistance to environment factors.

A multilayered connection plate on polyimide base comprising layers of polyimide film having conductive paths placed on both surfaces of every layer is also known. In order to couple conductors, a metallized through holes 0.1 mm in diameter are formed within every layer. For connecting the layers electrically and mechanically into a multilayered printed circuit plate with the single conductor spreading topology are used specifically formed metallized through holes about 1.5 mm in diameter arranged in the form of matrix with a regular pitch common for all layers which form, after aligning, the matrix of channels piercing the multilayered plate throughout. The conductors and metallized holes are formed by methods of lithography and spraying the metallization with a subsequent galvanic build-up to a required thickness and tinning those places in which should be soldered joints. Assembling the layers into a multilayered structure is performed by soldering the joints between the metallized through holes with the methods of vacuum soldering (Панов Е.Н. Особенности сборки специализированных БИС на базовых матричных кристаллах. М.: "Высшая школа", 1990. С. 31-34. - Panov E.N. The peculiarities of assembling the specialized LSIC on basic matrix chips. Moscow: "Vysshaya Shkola", 1990. Pp. 31-34).

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Soldered joints between the through holes are contact nodes serving for electrical interfacing the conductive structures of all layers into a single connection scheme of the multilayered connection plate.

A utilization of the polyimide as an insulating material having unique electrophysical parameters provides high technological and operating features to polyimide multilayered connection plates.

However, the presence of the matrix of metallized through channels piercing the multilayered plate throughout presents difficulties in spreading the connections, which leads to an increase of the number of layers, to a degradation of the plate testability and reducing of plate reliability, as well as to an increase of the polyimide expenditure and complication of the plate producing technology. As a whole, all of this increases the cost and makes impossible to utilize such plates in mass production manufacturing.

A multilayered printed circuit plate with a high density connection is known, comprising pairs of connection layers produced by means of technological substrate and separated with electrical insulating adhesion gaskets to stick the connection layers together. The conductors of adjacent connection layers are interconnected electrically by contact nodes made in the form of metallized through hole (SU 970737 A, Int. Cl. H 05 K 3/46, 1981).

The multilayered plates made according to that invention, while solving the problem of increasing the contact spreading density at the cost of excluding through channels piercing the whole multilayered plate throughout, could not, however, comprise more than 4 metallized connection layers, which is a significant limitation for their usage in the modern equipment (in comparison, the multilayered polyimide plate could comprise up to 30 metallization layers).

The closest technical solution to the present invention by the technical essence and achieved result is a multilayered connection plate based on polyimide, comprising dielectric layers having conductive paths formed on their sur-

faces, and forming connection layers of the multilayered plate, and also contact nodes made in the form of soldered joints of aligned metallized holes in the connection layers, the nodes performing an inter-layer connection of conductive paths placed both on adjacent and remote connection layers (Панов Е.Н. Особенности сборки специализированных БИС на базовых матричных кристаллах. М.: "Высшая школа", 1990. С. 16-34. - Panov E.N. The peculiarities of assembling the specialized LSIC on basic matrix chips. Moscow: "Vysshaya Shkola", 1990. Pp. 16-34).

The main disadvantages of this technical solution are:

- a great expenditure of useful connection space due to the matrix of metallized through channels in the multilayered plate, the channels being formed by soldered metallized holes of the connection layers, which decreases substantially the specific of the interconnection spreading density and leads to an increase of the number of connection layers, and hence, to an increase in the labor input and cost, as well as to a decrease of the reliability of the whole plate due to an increase of the number of soldered joints;

- a presence of the insulating gaskets between the connection layers with two-side metallization, comprising the metallized holes in the places where the through channels pierce the multilayered plate, which leads to a factual doubling of the number of layers in the plate and doubling of the number of soldered joints, i.e., to a significant complication of the plate, and hence, to a rise of its cost and decrease of its reliability.

Summary of the invention

The problem to be solved by the present invention consists in creating a multilayered connection structure comprising contact nodes of an original design, which usage allows to significantly increase the specific contact spreading density while decreasing substantially a design complexity, labor input and cost

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of production of the connection layers and multilayered connection structure as a whole.

Moreover, a utilization of the proposed contact node allows to enhance the controllability, reproducibility and reliability of connections in the multilayered connection plate.

The indicated technical result is achieved at the cost of utilizing the original contact nodes in the design of the proposed multilayered connection structure, providing the electrical and mechanical connection between layers.

The set problem is solved with achieving the mentioned result by that in the multilayered connection plate comprising layers of a dielectric material having conductive paths on their surfaces, the layers being connection layers, and contact nodes in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by a conductive binding material, the contact nodes are made in the form of joints between the contacts, some of which contacts are contact pads coupled with conductive paths of the underlying connection layer, and other contacts aligned with said pads are made in the form of metallized holes formed as truncated cones in the upper-lying connection layer, the lesser bases of the truncated cones being faced to the contact pads of the underlying connection layer, and the greater bases of the truncated cones being coupled with the conductive paths on the upper side of the upper-lying connection layer;

- and also by that the metallized contact pads are made flat;

- and also by that the upper bases of the truncated cones coupled with the conductive paths are made with metallized rims placed on the upper side of the connection layer;

- and also by that the diameter D of the greater base of the truncated cone, the width h of the metallized rim, the diameter d of the lesser base of the truncated cone, the thickness t of the dielectric material of the connection layer

and the minimal width L of a respective contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h.$$

In the this embodiment of the multilayered connection structure, the connection layers have only one-side metallization, which excludes the necessity in insulating gaskets.

The second embodiment of the multilayered connection plate is characterized by that the connection layers comprise the conductive paths on both surfaces interconnected with metallized through holes, an insulating layers with metallized through holes are placed between the connection layers, and the contact nodes additionally comprise an intermediate contacts in the form of aforementioned through holes.

The set problem is also solved by that in the multilayered connection plate the conductive paths are placed on both sides of every connection layer and interconnected with metallized through holes within every layer, insulating layers with metallized through holes are placed between the connection layers, and the contact nodes consist of metallized holes in the form of truncated cones made in the upper-lying connection layer, metallized through holes in the insulating layer, and contact pads coupled by conductive binding material on the underlying connection layer, the lesser bases of the truncated cones being jointed with the upper bases of metallized through holes of the insulating layer, and the lower bases of the through holes are jointed with the contact pads of the underlying connection layer, coupled with the conductive paths on the upper side of the underlying connection layer, the upper bases of the truncated cones being coupled with the conductive paths placed on the upper side of the upper-lying connection layer;

– and also by that the contact pads are made flat;

– and also by that the greater and lesser bases of the truncated cones coupled with the conductive paths on the surfaces of each connection layer are made with metallized rims around the periphery of the bases;

– and also by that the metallized through holes of insulating layers are made in the form of cylinders with metallized rims around the periphery of upper and lower bases.

Brief description of the drawings

Fig. 1, Fig. 1a and Fig. 2 depicts schematically the fragments of the proposed multilayered connection plate.

Embodiment 1 (Fig. 1) has a one-side metallization on every connection layer. Fig. 1a depicts the main parameters of the contact node.

Embodiment 2 (Fig. 2) has a two-side metallization on every connection layer.

The preferred embodiment of the invention

A multilayered connection plate consists of several connection layers. Fig. 1 represents in details three adjacent connection layers 1, 2, 3 and two contact nodes 4, 5.

The contact node 4 (enclosed in an oval) includes a contact pad 6 connected with a conductive path 7 on the upper side of the underlying connection layer 1, and a metallized hole 8 in the form of the truncated cone which greater base faces the upper side of the upper-lying connection layer 2 in the form of a metallized rim 9 coupled with the conductive path 10 on the upper side of the upper-lying connection layer 2. The joint between the contact pad 6 and the metallized hole 8, filled with a conductive binding material 11, forms the contact node 4 proper coupling the conductive paths 7 and 10.

In the case of assembling the contact nodes by spraying the binding material, each subsequent connection layer is aligned with the previous one by benchmarks, a protective mask is superimposed, aligned and fixed, after which an assembled technological stack is placed into the spraying plant, where a successive layer-by-layer spraying of the conductive materials forming a conductive binding structure with necessary features is performed. In such a way a group assembling of the contact nodes coupling the conductive paths in two adjacent connection layers could be performed.

After connecting the layers in the spraying plant, a visual and electrical control of the formed contact nodes is performed, if necessary, after which the process is repeated for the next connection layer etc. until the assembling of whole connection plate is finished.

When assembling the contact nodes by soldering, all connection layers are aligned in a necessary sequence, after which the stack is placed into the vacuum soldering plant. In conditions of a partial vacuum and common heating up to the temperature of solder melting a joint soldering in every contact node is occurred simultaneously in all layers of the multilayered connection plate under effect of capillary forces.

An interaction of the elements of the multilayered connection plate during its functioning occurs as follows (by the example of Fig. 1 fragment).

A signal from the conductive paths 10 of the connection layer 2 passes through the metallized hole 8 in the connection layer 2, conductive binding material 11 and contact pad 6 on the upper side of the connection layer 1, forming the contact node 4, into the conductive path 7 of the connection layer 1,

and then, through the metallized hole 13 in the connection layer 1, conductive binding material 14 and contact pad 12 on the upper side of the connection layer 3, forming the contact node 5, into the conductive path 15 of the connection layer 3.

A fragment of the second embodiment of the multilayered connection plate, on the base of connection layers with two-side metallization, is depicted in Fig 2, where three adjacent connection layer 1, 2, 3 separated by insulating layers 16 and 20, and also two contact nodes 4, 5 are represented.

The contact node 4 (enclosed in an oval) includes a contact pad 6 coupled with a conductive path 23 on the lower side of the underlying connection layer 1 through the conductive path 7 on the upper side of the underlying connection layer 1 and a metallized through hole 19, a metallized through hole 16 in the insulating layer 16 and a metallized hole 8 in the form of the truncated cone, which greater base faces the upper side of the upper-lying connection layer 2 in the form of a metallized rim 9 coupled with the conductive path 22 on the lower side of the upper-lying connection layer 2 through the metallized through hole 21 and the conductive hole 10. The joint between the contact pad 6, metallized through hole 17, and the metallized hole 8, filled with the conductive binding material 11, forms the contact node 4 proper coupling the conductive paths 22 and 23 of the connection layers 1 and 2.

Similarly, the joint between the contact pad 12 of the underlying connection layer 3, metallized through hole 18 in the insulating layer 20 and a metallized hole 13 in the upper laying connection layer 1, filled with the conductive binding material 14, form the contact node 5 (enclosed in an oval) coupling the conductive paths 7 and 15 of the connection layers 1 and 3.

The operating of the second embodiment of the multilayered connection plate is fully similar to the above described operating of the first embodiment of the plate.

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In forming the holes in the form of the truncated cone in the dielectric material of the connection layer during the process of fluid etching through the protective mask, as a result of the side etching effect, the following relationship between the main parameters of the contact nodes elements takes place:

$$L \geq D + 2h = d + 2t + 2h, \text{ where:}$$

D is a diameter of the greater base of the truncated cone;

h is a width of the metallized rim, by means of which the metallized hole is coupled with the conductive paths on the surface of the connection layer;

d is a diameter of the lesser base of the truncated cone;

t is a thickness of the dielectric material of the connection layer;

L is a minimal width of a respective contact pad on the underlying connection layer.

Industrial applicability

A manufacturing of the multilayered connection plates with contact nodes of the proposed design allows to provide:

- a high reproducibility and reliability of a great number of contact nodes coupling the connection layers in the multilayered connection plate;

- a high contact spreading density with the optimal number of the layers (from the viewpoint of the manufacture adaptability and cost of the producing the multilayered plates);

- a high precision of the multilayered connection structures and mounting elements on their surfaces, sufficient to manufacture the multichip modules;

- a simplicity of the design, defining a high adaptability to manufacture and low cost of the producing the multilayered connection plates.

Claims

1. A multilayered connection plate comprising layers of a dielectric material having conductive paths on their surfaces, the layers being connection layers, and contact nodes in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by a conductive binding material, *characterized* in that the contact nodes are made in the form of joints between the contacts, some of which contacts are contact pads coupled with conductive paths of the underlying connection layer, and other contacts aligned with said pads are made in the form of metallized holes formed as truncated cones in the upper-lying connection layer, the lesser bases of the truncated cones being faced to the contact pads of the underlying connection layer, and the greater bases of the truncated cones being coupled with the conductive paths on the upper side of the upper-lying connection layer.

2. The multilayered connection plate according to claim 1, *characterized* in that the contact pads are made flat.

3. The multilayered connection plate according to claim 1, *characterized* in that the upper bases of the truncated cones coupled with the conductive paths on the surface of the connection layer are made with metallized rims around the periphery of the bases.

4. The multilayered connection plate according to claim 3, *characterized* in that the diameter D of the greater base of the truncated cone, the width h of the metallized rim, the diameter d of the lesser base of the truncated cone, the thickness t of the dielectric material of the connection layer and the minimal width L of the respective contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h.$$

5. A multilayered connection plate comprising layers of a dielectric material with conductive paths on their surfaces, the layers being connection layers,

and contact nodes in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by conductive binding material, *characterized* in that the conductive paths are placed on both sides of every connection layer and interconnected with metallized through holes within every layer, insulating layers with metallized through holes are placed between the connection layers, and the contact nodes consist of metallized holes in the form of truncated cones made in the upper-lying connection layer, metallized through holes in the insulating layer, and contact pads coupled by conductive binding material on the underlying connection layer, the lesser bases of the truncated cones being jointed with the upper bases of metallized through holes of the insulating layer, and the lower bases of the through holes are jointed with the contact pads of the underlying connection layer, coupled with the conductive paths on the upper side of the underlying connection layer, the upper bases of the truncated cones being coupled with the conductive paths placed on the upper side of the upper-lying connection layer.

6. The multilayered connection plate according to claim 5, *characterized* in that the contact pads are made flat.

7. The multilayered connection plate according to claim 5, *characterized* in that the greater and lesser bases of the truncated cones coupled with the conductive paths on the surfaces of every connection layer are made with metallized rims around the periphery of the bases.

8. The multilayered connection plate according to claim 5, *characterized* in that the metallized through holes of the insulating layers are made in the form of cylinders with metallized rims around the periphery of the upper and lower bases.

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Abstract

The invention relates to the development and production of an equipment based on microelectronics components and semiconductor devices, and may be widely used in the production of multilayered connection plates as well as the connection structures for multichip modules. The multilayered connection plate comprises layers of a dielectric material having conductive paths on their surfaces, the layers being connection layers (1), (2), (3), and contact nodes (4), (5) in the form of metallized contacts mutually aligned and interconnected electrically and mechanically by a conductive binding material (11), (14), the contact nodes being made in the form of joints between the contacts. The second embodiment of the multilayered connection plate is characterized in that the conductive paths are placed on both sides of each connection layer (1), (2) and coupled with each other by metallized through holes (21), (19) within each layer.

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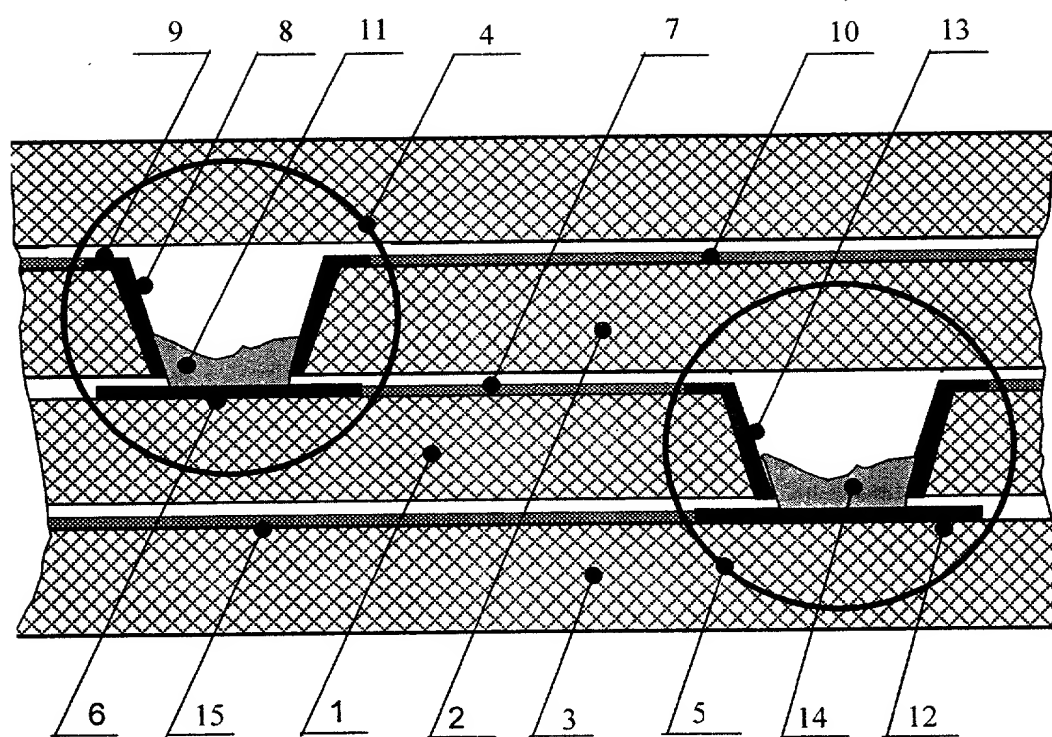


Fig.1

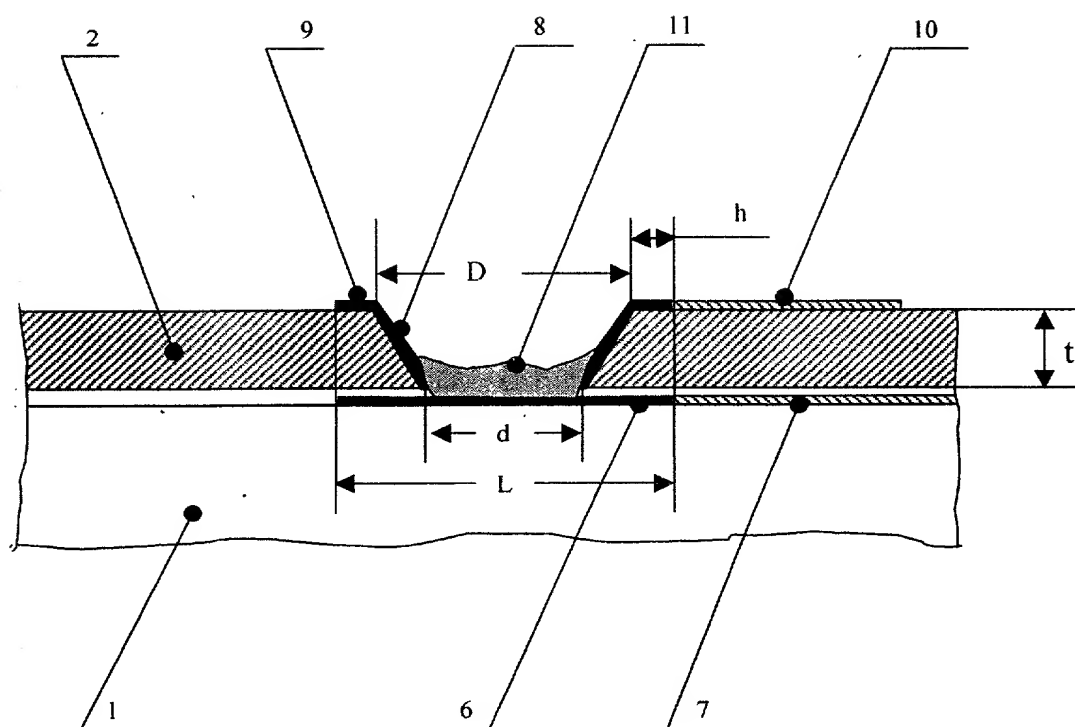


Fig. 1a

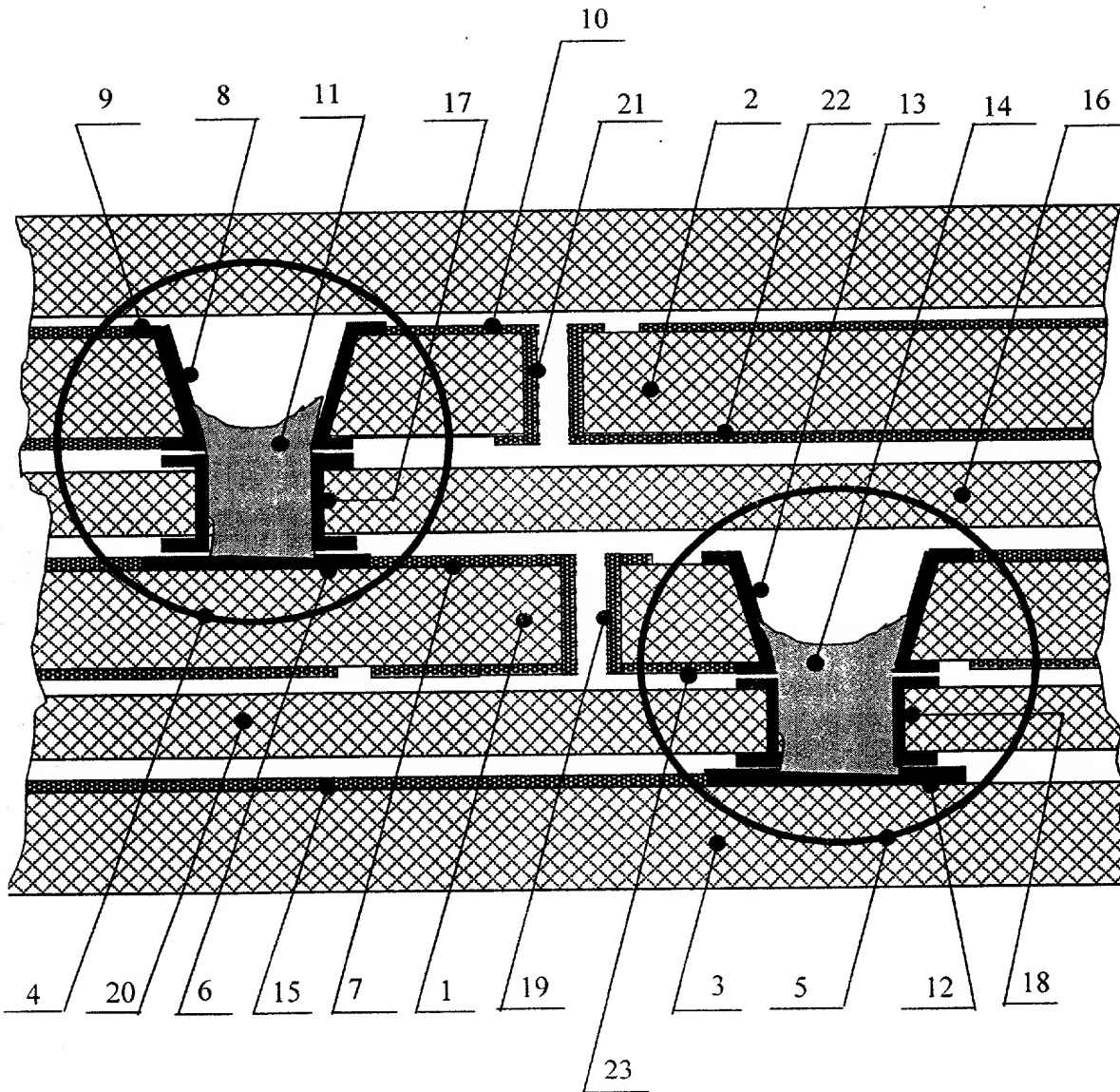


Fig. 2

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **MULTILAYERED CONNECTION PLATE**

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application

Serial No. _____

on _____

and was amended

on _____ (if applicable).

☐ was filed as PCT international application.

Number **PCT/RU 99/00053**

on **01 March 1999**

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY in PCT (indicate PCT)	APPLICATION NUMBER	DATE OF FILING day, month, year	PRIORITY CLAIMED UNDER 35 USC 119
RU	98121772/09	08 December 1998	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

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Combined Declaration For Patent Application and Power of Attorney (Continued) <small>(Includes Reference to PCT International Applications)</small>					ATTORNEY'S DOCKET NUMBER
<p>I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:</p>					
PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:					
U.S. APPLICATIONS			STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED	
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)					
Send Correspondence to:			Direct Telephone Calls to: <small>(name and telephone number)</small>		
201	FULL NAME OF INVENTOR	FAMILY NAME <u>TARAN</u>	FIRST GIVEN NAME <u>Alexander</u>	SECOND GIVEN NAME <u>Ivanovich</u>	
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	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>103575, Zele nograd, korp. 1001, kv.8</u>	CITY <u>Moscow</u>	STATE & ZIP CODE/COUNTRY <u>Russian Federation</u>	
	FULL NAME OF INVENTOR	FAMILY NAME <u>LJUBIMOV</u>	FIRST GIVEN NAME <u>Viktor</u>	SECOND GIVEN NAME <u>Konstantinovich</u>	
202	RESIDENCE & CITIZENSHIP	CITY <u>Moscow RUV</u>	STATE OR FOREIGN COUNTRY <u>Russian Federation</u>	COUNTRY OF CITIZENSHIP <u>Russian Federation</u>	
	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>103482, Zele nograd, korp. 360, kv.375</u>	CITY <u>Moscow</u>	STATE & ZIP CODE/COUNTRY <u>Russian Federation</u>	
	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
203	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY	
	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME	
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY	
<p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.</p>					
SIGNATURE OF INVENTOR 201		SIGNATURE OF INVENTOR 202		SIGNATURE OF INVENTOR 203	
DATE <u>01.02.2001.</u>		DATE <u>01.02.2001</u>		DATE	

Applicant or Patentee: Alexander I. Taran et al. Attorney's
 Serial or Patent No.: _____ Docket No.: _____
 Filed or Issued: _____
 For: Multilayered connection plate

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
 STATUS (37 CFR 1.9 (f) and 1.27 (b)) - INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9 (c) for purposes of paying reduced fees under section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled Multilayered connection plate described in:

☒ the specification filed herewith
☐ application serial no. _____, filed _____
☐ patent no. _____, issued _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9 (c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a nonprofit organization under 37 CFR 1.9 (e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

☐ no such person, concern, or organization
☒ persons, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)


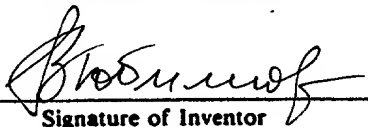
FULL NAME TARAN ALEXANDER IVANOVICH
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☒ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

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☒ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

FULL NAME _____
 ADDRESS _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

TARAN, Alexander I.	LJUBIMOV, Viktor K	
NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
		
Signature of Inventor	Signature of Inventor	Signature of Inventor

Date 01.02.2001 Date 01.02.2001 Date _____